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ABSTRACT

This student module on personal protective equipment is one of 50 modules concerned with job safety and health. This module explains the need for personal protective equipment, how it is selected, and the way in which the equipment is supposed to work. Following the introduction, 13 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., List the types and uses of safety shores). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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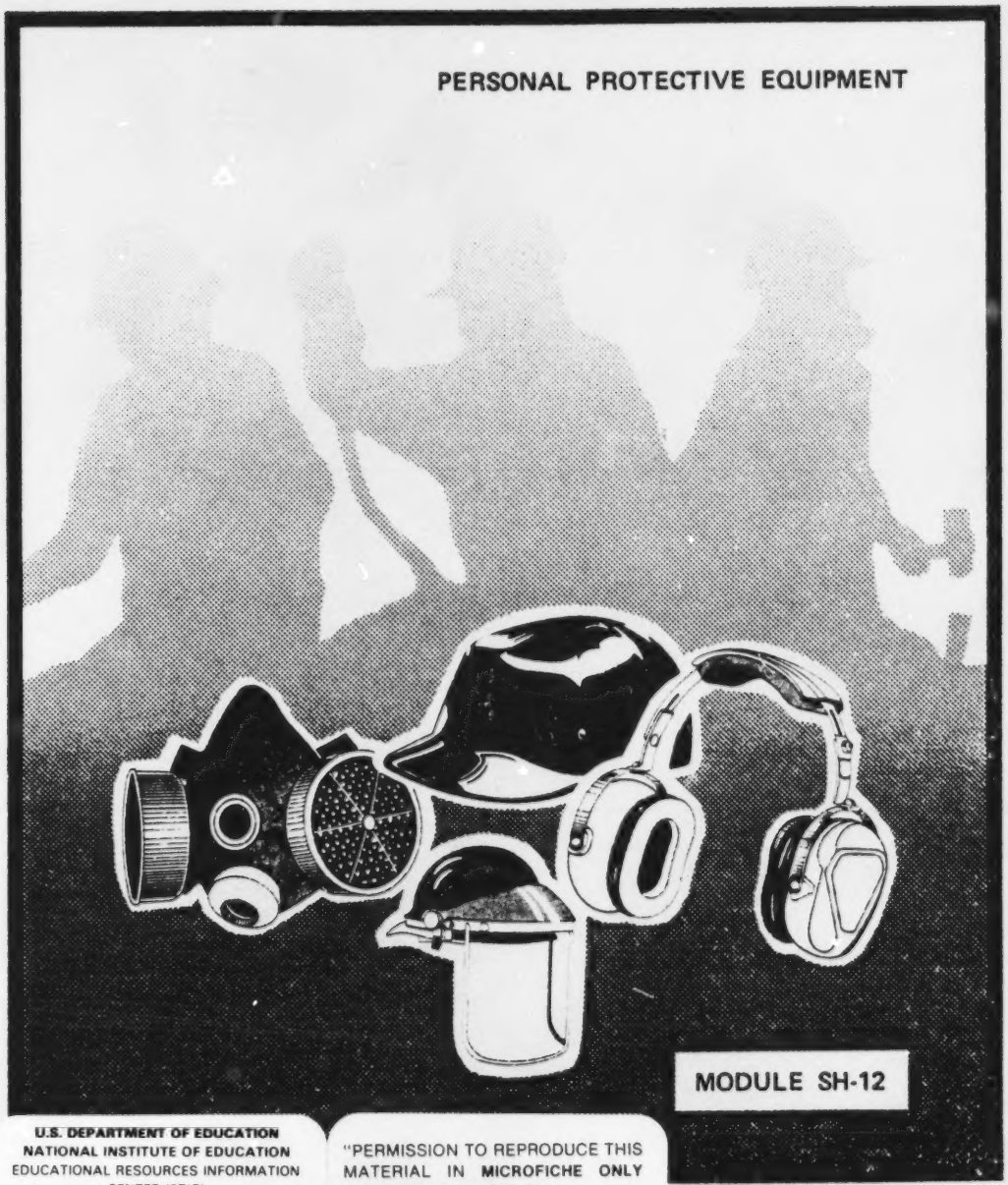
ED213846

SAFETY AND HEALTH

PERSONAL PROTECTIVE EQUIPMENT



MODULE SH-12

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The Center for Occupational Research and Development
601 Lake Air Drive, Suite C
Waco, Texas 76710

INTRODUCTION

Many industrial processes can be set up in such a way that workers are not exposed to hazardous materials or equipment. When hazards cannot be controlled through changing work operations, personal protective equipment such as safety glasses, gloves, or respirators will often provide the worker with a defense against injury or ill health.

The wearing of personal protective equipment (PPE) is a safety precaution in which workers participate directly. While the employer may select and provide PPE, the worker actually wears it. Therefore, it is the worker who must understand the need for such equipment, the factors that enter into its selection, and the specific way in which the equipment is supposed to work.

Personal protective equipment plays an important role in personal safety, as has long been recognized. The ancient civilizations used helmets and armor of different types to protect themselves in war. Miners developed crude respirators from pig bladders. Early divers fashioned goggles from thin shells to protect their eyes. Flint chippers used leather guards to protect their legs while fashioning flint tools and arrowheads. Today, personal protective equipment serves many of the same purposes as it did in the past. The design and use of personal protective equipment has become more sophisticated and, in many cases, more complex. However, it still serves as the final barrier to protect the worker.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. State the basis for choosing proper personal protective equipment. (Page 3)
2. Describe the use, classification, and special types of safety helmets available. (Page 5)
3. Discuss the purpose and frequency of audiometric testing. (Page 9)
4. Describe the main types of hearing protectors and current OSHA requirements. (Page 10)

5. Given a list of different types of eyeglasses and lenses, identify the ones that meet requirements for industrial-quality safety eyewear. (Page 13)
6. Given a specific job situation, select the general type of eye and face protection needed. (Page 15)
7. Discuss the importance of the correct selection of respiratory protectors. (Page 20)
8. Discuss the importance of inspection, storage, and training in the proper use of respiratory protectors. (Page 27)
9. List and describe the four classes of safety belts. (Page 29)
10. Discuss the selection, care, inspection of safety belts, and the significance of lifelines. (Page 30)
11. List the types and uses of safety shores. (Page 32)
12. Recognize situations in which hand protection should be used and when it should not be used. (Page 33)
13. Given a specific work situation, be able to suggest the proper protective clothing to be worn. (Page 34)

OBJECTIVE 1: State the basis for choosing personal protective equipment.

Personal Protective Equipment (PPE) ranges from head to toe. PPE design is as varied as its use, providing protection from a large number of possible hazards. PPE has been divided into seven major areas: head, ears, eyes and face, respiratory (breathing system), hands, body, and feet.

The PPE used in industry is designed to protect the worker from injury or harm. However, it is not designed to prevent the occurrence of an incident which might cause injury or harm. For that reason, simply wearing PPE should not be considered the single or most desirable solution to a possible occupational hazard. Other more permanent ways to reduce or prevent the potential exposure should be explored where possible.

Engineering controls are an attempt to do away with safety and health hazards at their source. For example, a machine used for grinding may be designed so that flying particles are confined by a machine guard or removed by an exhaust system. This method of removing the hazard is more basic and effective than the wearing of goggles to avoid injury from flying particles. In a similar way, harmful vapors would best be removed by a mechanical exhaust system or by physical separation in a closed vat or pipe, rather than by the wearing of respirators by workers.

Administrative controls are another possible solution; these do not eliminate hazardous conditions but they do reduce a worker's exposure to them. An example of administrative control would be job rotation, which consists of arranging schedules so that no worker spends too much time in an area where health might be endangered.

Where there is reasonable probability of injury, illness, or disease to the worker that cannot be controlled by other methods, PPE should be required. Once the decision (to use PPE) has been reached, care must be taken to make sure suitable equipment is chosen. This is done by reviewing sales material and comparing it with the standards set by organizations such as the American National Standards Institute (ANSI), National Institute for Occupational Safety and Health (NIOSH), American Society for Testing and

Materials (ASTM), manufacturer guidelines, and OSHA (Occupational Safety and Health Administrtion). In making the comparisons, two criteria (standards of judgment) should be used. The first is the degree of protection that a chosen item of PPE will give the worker. The second criteria is the ease with which it may be used. The best piece of equipment is useless unless it is actually used (Figure 1).

Figure 1. Safety clothing is not likely to be used unless it is comfortable.

Some employees may consider personal protective equipment a hindrance to them in their work: those who are aiming for higher production rates (in order to gain higher wages or maintain job security), or those who feel that perception and skill is reduced by PPE. In fact, PPE is compatible with productivity and competency. Workers who take pride in daredevil feats on the job need especially to realize that job safety is related to job skill.

The person wearing PPE should be convinced it is necessary and should understand how it works. It needs to be designed so that it is appropriate for the worker in the environment (surroundings) in which it will be used. A written PPE program for the users of the equipment should be in effect, and workers should be informed about the basic general requirements for PPE under the law, which are listed below:

- APPLICATION. Protective equipment, including personal protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices, and protective shields and barriers,

shall be provided, used and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

- EMPLOYEE-OWNED EQUIPMENT. Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.
- DESIGN. All personal protective equipment shall be of safe design and construction for the work to be performed.

ACTIVITY 1:*

List two criteria for selecting proper PPE.

1. _____
2. _____

OBJECTIVE 2: Describe the use, classification, and special types of safety helmets available.

The "hard hat" or safety helmet has become the symbol of the American construction worker and, in many instances, the plant worker also. The widespread use of hard hats represents a change in society's acceptance of PPE from outright dislike to its acceptance as a symbol worn with pride.

The need to wear head protection is well justified. A recent survey of workers who suffered injuries to the head showed that most of them were not wearing head protection. One-third of the 1033 accidents studied resulted from falling objects striking the head. Over half of those objects weighed at least eight pounds.

In recent history, protective headgear has developed from the basic steel helmet used by American soldiers in World War I to today's selection of protective headgear for both military and civilian use. Those World War I helmets generally fit poorly, requiring the soldier to place one hand on the helmet during vigorous activity to prevent its falling off. Although present-day protective headgear has come a long way since then, the need

*Answers to Activities begin on page 37.

for further improvement is recognized.

Safety helmets are used to protect the head from flying objects, impact, and electrical shock. (See Figure 2.) They can also help protect against falling liquids such as acids, and can prevent hair from getting tangled in machinery.

Figure 2. Safety helmets are used to protect the head from flying objects, falling liquids, and electrical shock.

Protective headgear (safety helmets) has been divided into two types. (See Figure 3.) Type 1 is a helmet with a full brim, and Type 2 is a brimless helmet with a peak. Because of the diverse use of these helmets, they have been further divided into four classes:

- Class A is designed for limited voltage resistance for general use.
- Class B is designed for high voltage resistance with a dieelectric (nonconducting) strength of 20,000 volts a.c.
- Class C offers no voltage protection. The lightweight aluminum helmets are an example of this class.
- Class D helmets offer limited voltage protection for firefighters. This class only applies to Type 1 designs with the full brim.

Figure 3. Type 1 helmets have a full brim; Type 2 have only a peak.

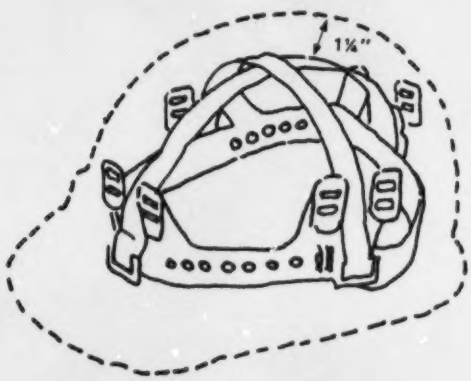

Figure 4. A hard hat suspension system fits inside, offering an adjustable fit to cushion any blow.

The helmets must have the manufacturer's name and the ANSI designation and class on the inside of the shell and a 1 1/4-inch or greater clearance between the head and the helmet shell. (See Figure 4.) This clearance is called crown clearance. The headbands must adjust in half-sizes. The bands supporting the helment should be non-irritating and follow the ANSI weight limits.

Many of these helmets are designed with approved attachments that give greater protection to the wearer. Chinstraps hold the helmet in place while winter liners made specifically for use with the helmet protect against cold weather. Some helmets have flip-up face shields attached to them (Figure 5). Others may have attached ear muffs for hearing protection. Miners have specially designed helmets with a low crown, and a lamp bracket with a cord holder. These attachments allow the miners the full use of their hands while working underground.

The helmets come in a variety of colors, and special markings may be included on the helmet. However, it is not advisable to spray-paint these helmets because it may reduce the electrical protection properties or weaken the shell. Drilling holes in the helmet to improve air flow is dangerous for the same reasons, as well as weakening the helmet's structure.

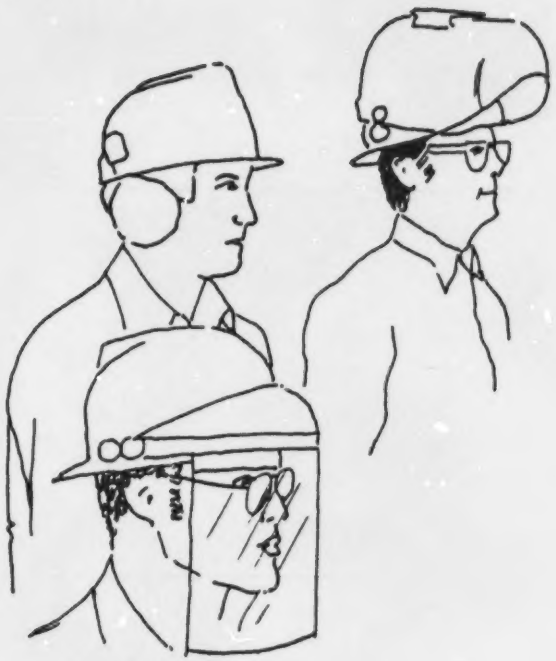

Figure 5. Several types of personal protective equipment can be attached to some safety helmets. Shown here are ear protection, face shield, and welding helmet.

Bump caps are a type of headgear with limited use. They are designed to be lightweight, small, and thin-shelled to give limited protection in close spaces and operations such as aircraft manufacture and meat processing.

Head protection is not limited to the classic hard shell design. Protective headgear is sometimes only a cap with a visor that acts as a feeler guard and helps prevent hair from getting caught in moving machinery. Other "soft" protective headgear includes the all-purpose buoffant (puffed out) cap used in clean rooms and laboratories. Protective headgear provides protection against some types of physical injury, and helps to keep dust and other particles away from the scalp, thus reducing the possibility of dermatitis (skin irritation).

Firefighting helmets have special design features to protect the firefighters from burning embers. The neck is protected by an extended rim in the back. A broad rim all the way around helps to deflect falling objects, and the attachable face shield protects against the heat.

ACTIVITY 2:

List two kinds of protection which can be provided by the appropriate safety helmet.

1. _____
2. _____

OBJECTIVE 3: Discuss the purpose and frequency of audiometric testing.

Earmuffs and earplugs are often used to protect against hazardous noise levels where noise cannot be adequately controlled at its source. Audiometric testing, or measurement of a person's hearing ability should be a basic part of any program to protect workers from damage to their hearing. A first audiometric test shows how well the worker hears and sets a level of hearing with which later tests can be compared. Such a test can also be used to put a worker in a job suitable to his or her hearing ability, and can tell a worker if medical help is needed for a hearing disorder. The test is carried out in a test booth that meets special standards (see Figure 6).

Figure 6. A portable sound booth for use in audiometric testing.

Periodic or follow-up audiometric testing is needed to detect shifts in hearing levels. If there is a significant hearing shift, it might indicate that the personal protective equipment is not being used properly, or it could indicate that the noise levels are greater than expected, or that the hearing protection is not sufficient.

An audiogram, a graph showing hearing ability in each ear, provides a permanent record of the individual's hearing activity. Note that in Figure 7 the hearing threshold level is expressed in decibels (dB). A decibel is a unit for measuring the relative loudness of sound. The threshold of hearing ("0" dB) is the weakest or quietest sound that can be heard by a person with very good hearing in an extremely quiet place. The loudness of noise increases at a greater rate than the numbers of the decibel scale indicate: a jet engine noise during take-off, at 125 dB, is more than 10 times as loud as conversation, at 55 dB. A Hertz is a unit of frequency equal to one cycle per second. Frequency determines the pitch of a sound (how high or low the sound is).

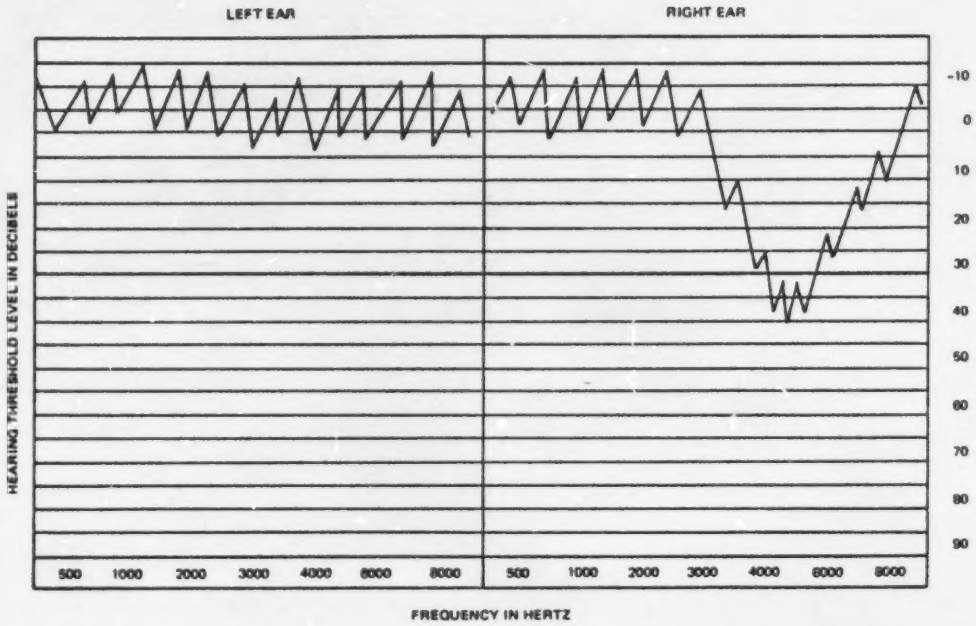

Figure 7. Audiogram showing right ear noise-induced hearing loss.

Note the frequency range where hearing has deteriorated. The 4000 Hertz (Hz) freuqency has long been considered the "fingerprint," or first sign of noise-induced (caused by noise) hearing loss regardless of the noise source. Noise-induced hearing loss is not always related to the job. Any noise source, such as home workshops, shooting, or motorcycle racing may cause noise-induced hearing loss.

ACTIVITY 3:

What is the function of audiometric testing and when is it used? _____

_____

_____

OBJECTIVE 4: Describe the main types of hearing protectors and current OSHA requirements.

Once the need for hearing protection has been shown by a noise survey of the work area, the appropriate earplug or muff (Figure 8) must be chosen. This choice should be based upon the amount of protection (called attenuation)

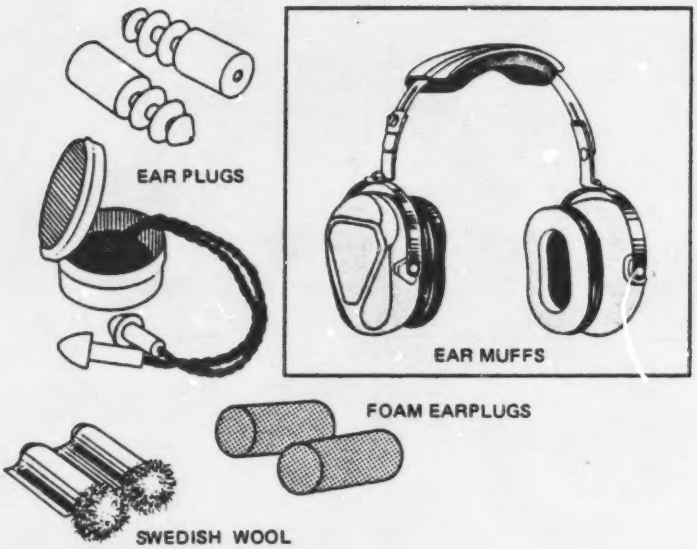

Figure 8. Hearing protection.

that is needed. The working conditions in which it will be used must also be considered. If hands remain dirty and the worker must periodically remove the protective equipment, muffs would be the better choice because an earplug could get dirty and cause an ear infection. If the working conditions are hot and the worker does not need to remove the hearing protection often, earplugs might be a good choice because the muffs would be very uncomfortable due to the heat.

The hearing protection devices in Figure 8 represent only a portion of a variety of types and designs available to the worker. Before any type of hearing protection is selected, its ability to attenuate the noise must be determined. Cotton is never recommended because it reduces very little, if any, noise exposure and can cause ear problems if not kept clean. In addition, hearing protection must be chosen to fit the worker. It is important to remember that in many cases the size of the ear canal on the right side and the canal on the left side of an individual is different. Therefore, each ear must be measured for correct fit when using earplugs.

If ear muffs are used, the wearing of glasses may cause the ear muffs to be ineffective. When the temple bars of the glasses that go over the ear are in place, the muff cannot complete a total seal around the ear. Even the smallest break in the seal can reduce the wearer's protection significantly.

Earplugs and ear muffs vary greatly in their effectiveness, depending on how well they are made and the type chosen. In general, properly fitted earplugs can provide a noise reduction to the ear of about 20 to 30 decibels (dB) at the higher, more damaging frequencies. These frequencies are often measured by industry on a scale known as the A scale. The dBA (decibels measured

on the A scale) measures noise in a manner that copies the way the ear hears sound. Lower frequency (bass) sounds are filtered out and not considered. Assuming 90 dBA average to be an acceptable noise level for an eight-hour work day, some plugs can protect the wearer up to sound levels of about 115 dB. Properly fitted muffs can provide about 30 to 40 dB attenuation with protection up to about 125 dB. By combining with plugs, a maximum of 5dB more reduction may be achieved. Using muffs and plugs cannot provide a noise reduction over about 50 dB because of the skull's noise conducting ability. All of these attenuation levels are based on laboratory conditions more ideal than those usually found in the workplace.

The Occupational Safety and Health Act provided for protection against occupational noise exposure by stating that protection against excessive noise must be provided. The Act stated further that if engineering or administrative controls were not available, personal protective equipment must be provided and used to reduce sound levels to acceptable levels (90 dBA average over an eight-hour day).

An amendment to the OSHAct is under consideration at the time of this writing. This amendment will lower the acceptable decibel levels to 85 dBA under certain conditions, and will describe requirements for many facets of hearing protection. (Further information may be requested by contacting the Office of Physical Agents Standards, OSHA, Room N-3718, U.S. Department of Labor, 200 Constitution Avenue NW, Washington, DC 20210, phone [202] 523-7151.)

ACTIVITY 4:

1. What are the two main types of hearing protectors available today?

   _____

2. The OSHA requirements for hearing protection specify which of the following is an acceptable dBA average over an eight-hour work day:
   a. 50 dBA.
   b. 115 dBA.
   c. 90 dBA.
   d. 35 dBA.

OBJECTIVE 5: Given a list of different types of eyeglasses and lenses, identify the ones that meet requirements for industrial-quality safety eyeglasses.

The National Society to Prevent Blindness asserts that half of all blindness can be prevented, and that 90% of all eye damage can be prevented. Despite the fact that eyes are the parts of the body that are most vulnerable to on-the-job injury, many people continually choose not to protect their eyes. The vital parts of the eye have few natural defenses, so it is necessary to provide barriers to injury in the form of goggles, spectacles, or face shields. Today, eye protection is readily available, inexpensive, and comfortable to use.

All eye protection equipment must meet the current standards (set up in the "American National Standard Practice for Occupational and Educational Eye and Face Protection, Z87.1 - 1979").

Safety spectacles that meet ANSI requirements have several advantages over street eyewear:

- Greater thickness helps to resist breaking (at least three millimeters in thickness).
- Special manufacture or treatment gives greater strength (able to stand up to being hit by a one-inch diameter steel ball dropped 50 inches).
- Lenses fitted into the front of the frame prevent the lens from being pushed into the eyes on impact.
- Frames made of special materials have greater strength and flame resistance.
- Side shields (on some safety glasses) can afford added protection.

"Impact-resistant" lenses are required for the general public by the Federal Food and Drug Administration (FDA); however, these streetwear glasses do not meet the safety standard of ANSI and, therefore, do not belong in the industrial environment. Industrial-quality prescription eyeglasses are available; if they meet the ANSI Z87.1 requirements, the manufacturer's trademark and the Z87 logo will be on the spectacle fronts and temples, and the lenses will bear the prescription maker's logo or monogram.

Contact lenses do not provide eye protection in the industrial sense; when they are used, they should not be depended upon for protection. In many

industrial environments, contacts should not be worn at all. When the work environment exposes the worker to chemical fumes, vapor, splashes, intense hear, molten metals, dusts or other particles, contact lenses are not advised. In contaminated areas where respirators are worn, contact lenses are forbidden by law.

Phototropic lenses are those which change their depth of tint in response to light. These lenses do not meet industrial requirements. If a worker must wear prescription tinted lenses, industrial-quality eye and face protection must also be worn.

The important thing to remember is that if you wear glasses or lenses to correct your vision, you still need eye protection in the industrial environment, since even impact-resistant streetwear glasses do not give sufficient protection.

The lenses of industrial-quality safety glasses may be made of glass or a variety of plastics. Most eye protection is now plastic. Glass and plastic both have advantages and disadvantages in durability and comfort. Questions regarding chemical reactions, breakage due to heat and sharp objects, abrasion (scraping) resistance, and fogging of the lens must be answered when choosing a lens type. Both types can meet protection standards, but one may be more appropriate than the other for a particular job. For instance, a plastic lens may not be appropriate where operations generate a great deal of heat, while glass lens would be unsuitable where flying particles could cause scratching of the lens. To choose, between glass and plastic lenses, several things should be considered:

- Both can pass impact tests when made to a standard thickness and consistency.
- Glass is slightly less resistant to breakage from sharp objects.
- Plastics may react with some chemicals on the surface but they are able to stop splashes and protect the eyes.
- Plastic lenses generally take longer to fog.
- Small objects moving at high rates of speed are resisted somewhat more successfully by plastic than by glass.

"Visitors' specs" are goggles that are sometimes given to plant visitors during a tour. These "visitors' specs" are not safety glasses of industrial quality, and they should never be used by workers in place of adequate eye

protection. In fact, it would really be better to give visitors a pair of industrial-quality safety glasses to wear during their plant walk-through.

ACTIVITY 5:

1. Place a check beside the item(s) that meet requirements for industrial-quality safety eyeglasses.
   - _____ a. All eyeglasses with plastic lenses.
   - _____ b. Eyeglasses marked with the manufacturer's name and the Z87 logo.
   - _____ c. Contact lenses, if they are worn with respirators.
   - _____ d. Phototropic lenses.
   - _____ e. "Visitors' specs."
2. Mark true or false beside each of the following statements:
   - _____ a. You do not need safety eyewear if you wear regular glasses that have impact-resistant lenses.
   - _____ b. All safety eyewear is equally useful in any situation.
   - _____ c. Safety glasses have thicker lenses than regular eyewear.

OBJECTIVE 6: Given a specific job situation, select the general type of eye and face protection needed.

Employers must provide eye and face protection for the workers on any job where there is a reasonable probability of injury to the eyes and face. Dangers such as flying objects, glare, harmful liquids, or injurious (causing injury) radiation call for eye protection, and sometimes for face protection, too. OSHA has several general rules about eye and face protectors:

- They shall provide adequate protection against the particular hazards for which they are designed.
- They shall be reasonably comfortable when worn under the designated conditions.
- They shall fit snugly and shall not unduly interfere with the movements of the wearer.
- They shall be durable.
- They shall be capable of being disinfected.

- They shall be easily cleanable.
- Protectors should be kept clean and in good repair.

Once again, it has been shown that a major factor of eye injuries is due to the lack of personal protective equipment being worn. A 1980 Bureau of Labor Statistics report on accidents involving eye injuries showed that of the people who suffered impact injuries or chemical burns to the eye, almost three out of five were not wearing eye protection. The remainder were wearing the wrong type of protection. Of the flying or falling objects that caused eye injury, four-fifths of those objects were smaller than one millimeter in diameter (or smaller than the diameter of a pencil lead).

When choosing the proper eye protection, consider first the protection it will give and the conditions under which it will be used. If comfort to the wearer is not considered, the protection will not be worn. Another consideration is durability and ease of maintenance in the work environment. If the lens becomes easily scratched or the frame is weak, the wearer may find the protection more of a handicap than an aid. Table 1 shows types of eye protection and their uses.

Welding produces some unusual hazards to the eye. Eye protection is required, and selection of the proper equipment is critical. Ultraviolet, visible, and infrared radiation hazards are added to the risk of injury from physical impact or possible chemical damages when welding.

To protect against the harmful radiation generated during welding operations, filter lenses have been designed to National Bureau of Standards specifications. The specifications are based upon the amount of light transmittance in the ultraviolet, visible, and infrared bands. A total of 16 filter lens shades are identified allowing a variety of lens choices to match the exposure. Shades 1.5 to 3.0 are useful for stray arc flashes and reflected radiation from welding and cutting operations. This range of shades is usually chosen for the welding goggles worn under the welding helmet. Where greater radiation intensity is found, shade No. 4 is used. Table 2 shows suggested shade numbers for different types of welding.

TABLE 1. SELECTION CHART FOR EYE AND FACE PROTECTORS FOR USE IN INDUSTRY, SCHOOLS, AND COLLEGES.

Selection Chart for Eye and Face Protectors for Use in Industry, Schools, and Colleges

This Selection Chart offers general recommendations only. Final selection of eye and face protective devices is the responsibility of management and safety specialists. (For laser protection, refer to American National Standard for Safe Use of Lasers, ANSI Z136.1-1976.)

1. GOGGLES, Flexible Fitting, Regular Ventilation
2. GOGGLES, Flexible Fitting, Hooded Ventilation
3. GOGGLES, Cushioned Fitting, Rigid Body
*4. SPECTACLES, without Sideshields
5. SPECTACLES, Eyecup Type Sideshields
6. SPECTACLES, Semi-/Flat-Fold Sideshields
**7. WELDING GOGGLES, Eyecup Type, Tinted Lenses (Illustrated)
7A. CHIPPING GOGGLES, Eyecup Type, Clear Safety Lenses (Not Illustrated)
**8. WELDING GOGGLES, Coverspec Type, Tinted Lenses (Illustrated)
8A. CHIPPING GOGGLES, Coverspec Type, Clear Safety Lenses (Not Illustrated)
**9. WELDING GOGGLES, Coverspec Type, Tinted Plate Lens
10. FACE SHIELD, Plastic or Mesh Window (see caution note)
* 11. WELDING HELMET

NON-SIDESHIELD SPECTACLES ARE AVAILABLE FOR LIMITED-HAZARD USE REQUIRING ONLY FRONTAL PROTECTION.
**SEE TABLE 2, "SELECTION OF SHADE NUMBERS FOR WELDING FILTERS."

APPLICATIONS

OPERATION	HAZARDS	PROTECTORS
ACETYLENE–BURNING ACETYLENE–CUTTING ACETYLENE–WELDING	SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES	7, 8, 9
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	2 (For severe exposure add 10)
CHIPPING	FLYING PARTICLES	1, 3, 4, 5, 6, 7A, 8A
ELECTRIC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	11 (In combination with 4, 5, 6, in tinted lenses, advisable)
FURNACE OPERATIONS	GLARE, HEAT, MOLTEN METAL	7, 8, 9 (For severe exposure add 10)
GRINDING–LIGHT	FLYING PARTICLES	1, 3, 5, 6 (For severe exposure add 10)
GRINDING–HEAVY	FLYING PARTICLES	1, 3, 7A, 8A (For severe exposure add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	2 (10 when in combination with 5, 6)
MACHINING	FLYING PARTICLES	1, 3, 5, 6 (For severe exposure add 10)
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	7, 8 (10 in combination with 5, 6, in tinted lenses)
SPOT WELDING	FLYING PARTICLES, SPARKS	1, 3, 4, 5, 6 (Tinted lenses advisable; for severe exposure add 10)

CAUTION:
- Face shields alone do not provide adequate protection.
- Plastic lenses are advised for protection against molten metal splash.
- Contact lenses, of themselves, do not provide eye protection in the industrial sense and shall not be worn in a hazardous environment without appropriate covering safety eyewear.

TABLES 1 AND 2 ARE REPRODUCED WITH PERMISSION FROM AMERICAN NATIONAL STANDARD PRACTICE FOR OCCUPATIONAL AND EDUCATIONAL EYE AND FACE PROTECTION, ANSI Z87.1–1979, COPYRIGHT 1979 BY THE AMERICAN NATIONAL STANDARDS INSTITUTE, COPIES OF WHICH MAY BE PURCHASED FROM THE AMERICAN NATIONAL STANDARDS INSTITUTE AT 1430 BROADWAY, NEW YORK, NEW YORK 10018.

TABLE 2. SELECTION OF SHADE NUMBER FOR WELDING FILTERS

Welding Operation	Suggested Shade Number*
Shielded Metal-Arc Welding, up to 5/32 in (4 mm) electrodes..	10
Shielded Metal-Arc Welding, 3/16 to 1/4 in (4.8 to 6.4 mm) electrodes.....	12
Shielded Metal-Arc Welding, over 1/4 in (6.4 mm) electrodes..	14
Gas Metal-Arc Welding (Nonferrous).....	11
Gas Metal-Arc Welding (Ferrous).....	12
Gas Tungsten-Arc Welding.....	12
Atomic Hydrogen Welding.....	12
Carbon Arc Welding.....	14
Torch Soldering.....	2
Torch Brazing.....	3 or 4
Light Cutting, up to 1 in (25 mm).....	3 or 4
Medium Cutting, 1 to 6 in (25 to 150 mm).....	4 or 5
Heavy Cutting, over 6 in (150 mm).....	5 or 6
Gas Welding (Light) up to 1/8 in (3.2 mm).....	4 or 5
Gas Welding (Medium) 1/8 to 1/2 in (3.2 to 12.7 mm).....	5 or 6
Gas Welding (Heavy) over 1/2 in (12/7 mm).....	6 or 8

*The choice of a filter shade may be made on the basis of visual acuity and may therefore vary widely from one individual to another, particularly under different current densities, materials, and welding processes. However, the degree of protection from raidant energy afforded by the filter plate or lens when chosen to allow visual acuity will still remain in excess of the needs of eye filter protection. Filter plate shades as low as shade 8 have proven suitably radiation-absorbent for protection from the arc-welding processes.

Note: In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the operation (spectrum).

Another form of eye protection is the chemical splash goggle. It is designed to protect the eyes from splashes of acids, caustics, and other harmful liquids and chemicals. The lens of these goggles should allow the

wearer to see without distortion and must be selected with a good understanding of where they will be used.

A 1980 Bureau of Labor Statistics (BLS) report clearly showed that almost all workers "who suffered impact injuries or chemical burns to the face were not wearing face protection at the time of the accident." Of the injuries studied, almost half resulted from flying or falling objects striking the face. Twenty percent of the injuries were due to swinging objects, and fifteen percent were due to objects or tools being pulled into the face. One interesting note to this study was that few workers complained about poor vision or discomfort from wearing face protection.

When face protection such as a face shield is worn, suitable eye protection must also be worn. This will help to protect the eyes if the wearer is struck in the face. Eye protection could prevent blindness in the case of a chemical being splashed under the face shield. Face shields are provided as clear shields, tinted shields, and wire screen shields. The clear shield protects against metal splashing and similar exposure. The tinted shield is used to protect against various types of radiation such as those developed when welding. The face shield is very useful in protecting the face against disfigurement and the loss of teeth, and the eyes against blindness in an accident. However, the American National Standards Institute does not recommend the face shield as the basic protection against impact. Proper goggles or safety glasses are worn under the face shield to provide this needed basic protection.

ACTIVITY 6:

Choose the best answer, using Table 1 or 2 as your guide.

1. Chemical handling would probably require which one(s) of the following types of protection?
   a. 1, 3, 4, 5, or 6.
   b. 2 and possibly 10.
   c. 11.

2. Machining that produces flying particles could require which one(s) of the following types of protection?
   a. 1 or 3.
   b. 5 or 6.
   c. Both a and b.
3. Carbon arc welding requires which shade number of welding filters?
   a. 12.
   b. 14.
   c. 2.

OBJECTIVE 7: Discuss the importance of the correct selection of respiratory protectors.

Respiratory protection (protection of the breathing passages) is perhaps the most complex of all personal protective equipment. To become highly qualified and knowledgeable about this equipment requires many hours of intensive training. The lack of such protection or its use can lead to severe consequences. With these thoughts in mind, consider the information in this objective only as a basic introduction to respiratory protective equipment and practices.

Respirators are divided into two general categories: air purifying and air supplied. The purpose of respirators is to protect the wearer from toxic (poisonous) contaminants by filtering out the contaminant (harmful substance) or providing breatheable air. The respirator may be only a mouthpiece or it may enclose the complete body. Between these two extremes are quarter-face, half-face, and full-face respirators (Figure 9). Each type with its proper filter or air supply provides a specific and sometimes limited amount of protection.

The quarter-face piece covers only the mouth and nose, with the lower sealing surface resting between the chin and mouth. The half-face mask fits over the nose, but the lower sealing surface is located under the chin, giving a more reliable seal. The full-face respirator covers the complete face from the hairline to below the chin. It provides the best protection and most reliable sealing surface.

Figure 9. Three respirator types.

Air-purifying respirators remove contaminants through chemical reaction or by filtering out the contaminant. This type of respirator does not supply oxygen to the wearer. If a person wearing a respirator was to enter an atmosphere lacking in oxygen, death could occur.

The air-purifying respirator is widely used in industry. One type of respirator has a filter made of a fibrous material designed to remove dust or fibers in the air. Some types of dust or fiber filters are designed for one-time, throwaway use. They resemble a surgeon's mask more than the respirators seen in Figure 9.

Other respirators will have a filter such as activated charcoal that allows the contaminant to be absorbed by the filter. This type of respirator is a gas- and vapor-removing respirator, and it is widely used in areas where the vapor or gas levels are not excessive.

At times it is necessary to provide protection from both dusts and vapors. When a situation of this nature occurs, it is usually a simple matter to provide a dust filter over a vapor respirator cartridge. The dust will be kept out by the filter and the vapor will pass through to be captured by the vapor respirator.

The wearer of air-purifying respirators needs to understand the equipment well enough to know its limitations. Misuse of respirators can cause serious injury or death. The advantages of air-purifying respirators are their small size, cost, and ease of maintanance. They are versatile, allowing the wearer

to change types of filters to meet the specific needs of protection from a possible exposure.

The disadvantages are that air-purifying respirators cannot be used in an oxygen-deficient atmosphere (one lacking in oxygen) or any atmospheres considered to be immediately dangerous to life and health. The quarter- and half-masks do not offer eye or face protection, and the amount of material that takes up harmful vapors is limited.

The second type of respiratory protective equipment is atmosphere or air-supplying respirators. This system supplies air that meets specifications for breathing. Ordinarily, it does not supply pure oxygen. (Certain closed circuit rebreathing devices do generate oxygen while recirculating the other constituents of breathing air. These have been successfully used in mine rescue applications.) The use of pure oxygen could allow a fire to start or speed up a chemical reaction in a work area. Within this category of air-supplying respirators, there are basically two types used to supply the air. One is a self-contained breathing apparatus, and the other is a supplied-air system. Examples of both types of air-supplying respirators are shown in Figure 10.

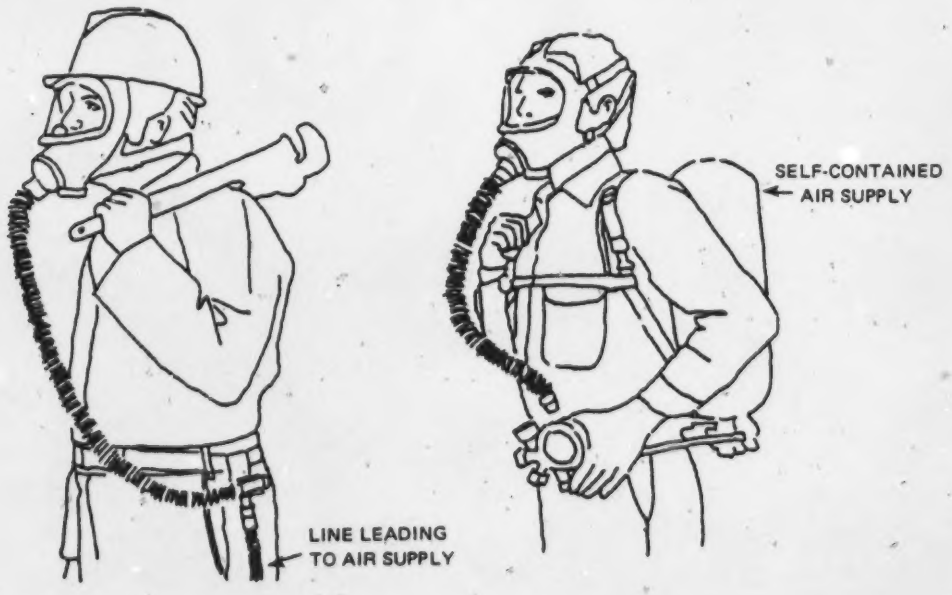

Figure 10. Supplied-air (airline) respirator (left) and self-contained air-supplying respirator (right).

A self-contained breathing apparatus (SCBA) allows the wearer greater flexibility since there is no hose connection or short-time limitations due to cartridge capability. The SCBA type respirator is widely used by fire-fighters and rescue units. They are divided into open-circuit and closed-circuit design.

Open-circuit designed SCBA allows the exhaled (breathed out) air to be vented to the atmosphere. Two types of open-circuit SCBA, demand and pressure demand, are in use today. Demand SCBA allows the wearer breathing air on demand. Air flows into the facepiece from the tank on the wearer's back only when the individual inhales (breathes in). Greater exertion provides more air as the wearer demands it. A drawback to this design is that as the wearer inhales, it creates a negative pressure in the facepiece. This can allow outside contaminated air to enter the facepiece and be inhaled by the user. For this reason, a demand type open-circuit SCBA should not be used in atmospheres immediately hazardous to life or health. Even with this concern, they may be used for protection in oxygen deficient atmospheres.

The pressure-demand type SCBA overcomes the problem of the demand type SCBA by keeping the facepiece under positive pressure at all times during use. This is done by incorporating special valving in the unit. A note of caution is in order at this point. A facepiece whose exhalation valve is designed for demand operation cannot be used with a pressure-demand regulator, as air will flow continually and quickly use up the air supply. (In short - do not attempt to interchange parts on any type of respirator.)

SCBAs of both closed- and open-circuit types have several safety features. These features include gages able to be seen by the wearer that indicate how much breating air is available, and a warning device such as a bell that indicates when the supply is about three-fourths expended. Fittings are designed to be incompatible with other sytems to help maintain the integrity of the SCBA.

Supplied-air respirators are generally referred to as airline respirators because an airline hose is connected to the wearer's equipment from a central location. A major advantage of this type of respirator is that it allows the wearer to work in a contaminated atmosphere for longer periods than the filter or SCBA's units. The air is supplied under pressure to the wearer through the hose. They are available in three types: demand, pressure demand, and

continuous flow. As explained earlier, these work with the addition of the continuous flow that always provides a specified minimum amount of air independent of user demand. They are not designed to be used in atmospheres considered immediately hazardous to life. The air-supply hose must be the one supplied by the manufacturer. To change it could jeopardize the wearer's life and would cancel the NIOSH (National Institute for Occupational Safety and Health) approval or other approval of the unit. (Never interconnect or alter the fitting with other fittings or devices.)

A concern with the use of supplied-air respirators is that the hose could be mistakenly connected to another gas outlet in a plant. This action could result in the wearer being supplied with an inert gas such as nitrogen, thereby harming or killing the wearer. This problem can be avoided by ensuring that the connections for breathing air are of a unique design and not compatible with any other fitting in the plant. In addition to protecting the worker, unique breathing air connections are also required by OSHA law (section 1910.134).

The regulation and control of all respiratory equipment is addressed by three standards. They are: Department of the Interior Bureau of Mines Respiratory Protective Devices, Tests for Permissibility and Fees, 30 CFR 11, published March 25, 1972; American National Standards Institute ANSI-Z88.2, 1980, (see Appendix); and OSHA regulation 29 CFR 1910.134. OSHA has chosen to accept only respirators approved by the National Institute for Occupational Safety and Health (NIOSH). These references should be consulted in developing any respirator protection program.

Once the understanding of the various respirator types and regulations governing their use is developed, the selection of the proper respirators may begin. They must be selected on the basis of the hazards to which the worker is exposed.

There is a series of rather basic yet logical questions that should be asked when selecting a respirator for routine use. In most instances, the following nine questions furnish enough information for that decision.

1. What is the estimated contaminant concentration (amount) where the respirator will be used?

2. What is the permissible exposure level (PEL) of the contaminant? PEL refers to the level of contamination in the environment to which a worker can safely be exposed.
3. Is the contaminant a gas, vapor, mist, dust, or fume?
4. Could the contaminant concentration be termed immediately hazardous to life or health?
5. If the contaminant is flammable, does the estimated concentration approach the lower explosive limit?
6. Does the contaminant have adequate warning properties? (Does the worker become aware of the contaminant quickly?)
7. Will the contaminant irritate the eyes at the estimated concentrations?
8. If the contaminant is a gas or vapor, is there an available sorbent (material that will absorb, or react to and hold) that traps it effectively?
9. Can the contaminant be absorbed through the skin as a vapor or liquid? If so, will it cause serious injury?

Table 3 contains a more detailed list of questions that could be used in selecting respirators. In the Appendix is a reprint of American National Standards Institute Z88.1-1980, "Respirator Program Requirements."

TABLE 3. RESPIRATOR SELECTION WORKSHEET.

1. Material –
   a. Chemical Name _____
   b. Trade Name _____
   c. Formula _____
   d. Allowable concentration limits, TLV or TWA:
      1) OSHA 1910.1000 _____
      2) Current ACGIH _____
      3) Short Term Exposure Limit (STEL) _____
2. Form in which it will be used –
   a. Liquid? _____ b. Solid? _____ c. Gaseous? _____
   d. If gaseous, is it an organic vapor? _____ or acid gas? _____ Other? _____
3. Maximum expected concentration –
   a. _____ parts per million, or
   b. _____ milligrams per cubic meter
   c. Duration of exposure to maximum expected concentration. _____
4. Will material be heated? _____ If so, to what temperature? _____
5. What is the odor threshold of the material? _____
6. At what concentration is the material considered to be immediately dangerous to life or health? _____
7. Can the substance be absorbed through the skin? _____
8. Irritant to the eyes? _____ respiratory tract? _____ skin? _____
9. At what concentration is it an irritant? _____
10. If the substance is known to be flammable, what are the lower and upper flammable limits, in percent by volume? _____
11. What is the vapor pressure of the material? _____
12. Will the material be mixed with other chemicals? _____ if so, give details: _____
13. Any possiblity of oxygen deficiency? Yes _____ No _____
14. Can good ventilation of the area be maintained? _____
15. Will the exposure be continuous? _____ intermittent? _____
16. Will the respiratory device be used for routine exposures, _____ as an escape device, _____ emergency reentry device? _____
17. Provide as much further detail as possible concerning exposure conditions. _____

*Adapted from Mine Safety Appliances Bulletin 1000-16.

ACTIVITY 7:

List five questions that should be asked when selecting a respirator for routine use.

1. _____
2. _____
3. _____
4. _____
5. _____

OBJECTIVE 8: Discuss the importance of inspection, storage, and training in the proper usage of respiratory protectors.

As with other aspects of respiratory protection, the training and use of the selected equipment is regulated. Without the proper training a wearer could find it useless. The wearer needs to understand the limitations of the equipment.

As a first step, the wearer must participate in a testing procedure to ensure that the face seal is complete. Respirator face seals are crucial to the proper functioning of the equipment. Facial hair, deep scars, or dentures can interfere with a proper seal and allow a contaminant to be inhaled by the wearer.

The wearer must be taught how the respirator works, its proper maintenance, and the consequences of abuse of the equipment. Specific information, such as air pressure or the fact that air-purifying respirators do not supply oxygen, is necessary for understanding the proper use of the equipment. An explanation of the respiratory hazard and of the factors considered in choosing the appropriate respirator should be part of the employee training. Specific instructions in how to wear the respirator properly and information

about how to handle emergency situations involving the respirator must also be given.

Prudence and law require that respirators be properly cleaned, maintained, and stored. They must be cleaned daily following the manufacturer's specifications, or if used by several individuals, sanitized. They must be inspected periodically (before each use) and appropriate maintanance performed by qualified, trained individuals. Storage must be in a cleaned and protected location such as in a plastic bag inside a locker rather than the bottom of a tool box.

The employer has the responsibility of providing the proper respirators where they are needed and for training the employees to use and maintain them. In turn, the employees must take responsibility for guarding the respirators against damage, reporting any noted malfunction, and most important, using the respirators. Responsibility for the respirator program must be given to a qualified (knowledgeable about the use and selection of respirators) individual. This person may be a foreman or superintendent, or in larger companies, an administrator whose main responsibility is the respirator program. This respirator program supervisor should work with medical personnel in assigning job duties that require the use of a respirator. Other duties of the program supervisor include the monitoring of the respiratory hazard, the respiratory equipment and its use.

ACTIVITY 8:

Which of the following would not be included in training employees in the use of respiratory protection? Circle the correct answer.

1. Testing of respiratory equipment for proper fit.
2. Instruction in cleaning and storage of respiratory equimpment.
3. Instruction in monitoring the respiratory hazard and the respiratory equipment and its use.
4. Information about the limitations of the equipment.

OBJECTIVE 9: List and describe the four classes of safety belts.

Safety belts are divided into four distinct classifications based upon their use. The classifications (shown in Figure 11) are: Class I, body belts; Class II, chest harness; Class III, body harness; and Class IV, suspension belts. An important factor to remember when using any safety belt is to ensure that it is attached properly and then firmly secured to an adequate support.

Figure 11. From left to right, body belt, chest harness, body harness, and suspension belt.

The body belt is designed to hold a person who might fall. It should keep the individual from falling from a dangerous level and is used where the worker will be restricted to limited movement and activity.

A chest harness is used where someone may need to be pulled out of a hazardous area, or could slide on a steep surface. The individual using this type of safety belt is allowed a great degree of freedom of movement.

A body harness is designed for use where the risk of falling is greatest. It has a large surface area contacting the individual. This surface area is very important in absorbing and distributing the shock of the sudden stop when the harness restrains the individual in a fall.

The suspension belt is both a safety belt and a work support for the individual. It is most useful in maintenance situations such as the painting and the inspection of surfaces such as industrial stacks that provide no work platform.

ACTIVITY 9:

List and describe four classifications of safety belts.

1. _____
   _____
2. _____
   _____
3. _____
   _____
4. _____
   _____

OBJECTIVE 10: Discuss the selection, care, and inspection of safety belts and the significance of lifelines.

In jobs involving climbing or working at heights, safety belts, lifelines, body harnesses, and lanyards may be necessary. Safety belts have two functions: normal, everyday use and emergency use. Normal use includes hoisting or lowering a person, or providing steady support while a worker carries out a task. Emergency use is the safe stopping of a worker if he or she should fall. Keep in mind that when an individual falls, the belt and its support equipment will be subjected to severe loading forces, many times the weight of the person using the belt. The length a person falls, the person's weight, and the suddenness of the stop are factors that determine the force the equipment must withstand.

When selecting a safety belt, "looks" and "feel" can be deceiving. Leather, traditionally associated with strength, is no longer considered acceptable material for a safety belt.

Web belts are considered dependable and resistant to environmental conditions. They are made of a variety of materials including cotton and nylon among other combinations. "Looks" and "feel" can also be deceiving when

evaluating web belts. Usually, the belts are made with a basket weave or a herringbone weave. The basket-weave belts look "tougher" and feel "stiffer," and they are. But the softer, more pliable herringbone weave will also absorb shock better than basket-weave belts.

Safety belts should be kept clean, away from excessive heat, and dried at room temperature. The web belts can be washed with soap and water, rinsed, and dried at room temperature. At all times, the manufacturer's guidelines for care and cleaning of safety belts should be followed.

Inspection of safety belts should be conducted before each use by the wearer and periodically by a trained inspector. Leather belts require close inspection for cuts and scratches, particularly those across the belt. Web belts should be checked for excessive wear on the exposed fibers. On all belts, the buckles, rivets, D-rings (see Figure 12), and other parts should be checked closely for any sign of excessive wear. Once inspected and accepted as usable, the belt must be worn properly to perform its job well.

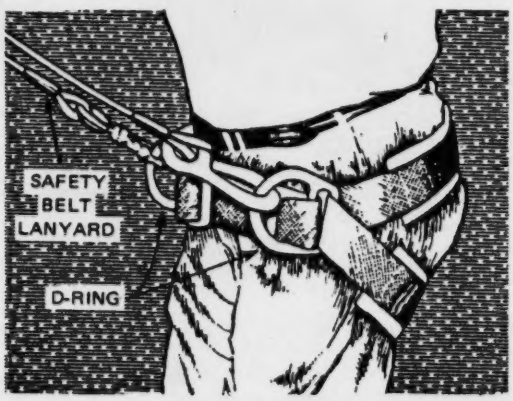

Figure 12. Multipurpose safety belt has two D-rings, one on each side.

Lifelines should be made of one-half inch nylon or the equivalent, and short enough to limit the fall to six feet or less. They should be secured to a sturdy structure above the worker. Since lifelines lose their strength where knots are tied or where kinks occur, they should be kept as short as is feasible. Lifelines should not be kinked in storage and should be kept clean and regularly inspected.

ACTIVITY 10:

Mark true or false beside the following statement.

_____ "Looks" and "feel" are usually good indicators for selection of web safety belts.

OBJECTIVE 11: List the types and uses of safety shoes.

Safety shoes are divided into five general types: safety toe, conductive, foundry, explosives operations, and electrical hazard shoes. Safety-toe shoes come in a wide range of types and designs ranging from dress shoes to rubber boots. (See Figure 14.) For work around extremely heavy operations such as the steel industry, these shoes can be fitted with metatarsal guards to protect the toes and instep of the foot. This type of foot protection is comfortable and lightweight. The wide selection of designs can meet most needs.

Figure 13. Variety of safety shoes.

Conductive shoes are designed to drain off static charges of the type experienced when walking across a carpet and touching a door handle. This type of shoe is used in areas where fire and explosion hazards exist.

Foundry shoes are designed to protect against splashing metal and may be quickly removed. Leggings are often added to afford more protection from molten metal between the foot and the knee. Wherever the possibility of splashing exists, quick removal of the protective footwear is important, and pants legs should be worn outside the footwear as an added protective measure.

Explosives operations shoes are of a nonsparking and nonconductive design. Their main use is in explosives manufacture and hydrocarbon cleaning operations.

Electrical hazard shoes are designed to protect the wearer from electrical shock; they are effective if properly maintained. Regular rubber boots are not designed for this purpose as they may have metal in their construction.

ACTIVITY 11:

Match the types of safety shoes with their uses by drawing a line between the shoe and its correct use.

1. Safety toe.	a. Designed to protect against splashing metal.
2. Conductive.	b. Designed to protect the wearer from electric shock.
3. Foundry.	c. For work around extremely heavy operations; can be fitted with metatarsal guards.
4. Explosives operations.	d. Designed to drain off static electricity charges.
5. Electrical hazard.	e. Made of nonsparking and nonconductive design.

OBJECTIVE 12: Describe situations in which hand protection should be used.

Arm, hand, and finger protective equipment is very useful for specific situations. A wire mesh glove is designed to protect the hand and fingers from cuts by sharp objects such as knives and blades used in the garment industry. Cotton gloves offer adequate protection in many instances. Leather gloves are used in welding operations and other heavy work. Rubber gloves protect against certain chemicals and water. Asbestos, loop pile and aluminized gloves are heat resistant. Plastic-dipped gloves are for oily work. Many gloves are designed for specific operations, such as a chrome leather welder's glove for arc welding, or an open-back leather palm pad for annealing operations. (See Figure 14.)

When working on most machinery, workers should leave gloves OFF. Rotating and moving equipment can catch the glove and pull someone's hand along with it.

Leather hand and arm protectors provide protection to the hand and arms. They are generally thicker and less flexible than gloves, and are used in

Figure 14. Various types of gloves: plastic, rubber, loop pile, wire mesh.

situations that do not require great flexibility. Examples are the handling of rough lumber or other sharp-edged materials. They should not be used around moving machinery.

ACTIVITY 12:

Describe the general circumstances in which protective gloves should not be worn.

_____

_____

_____

OBJECTIVE 13: Given a specific work situation, be able to suggest the proper protective clothing to be worn.

Protective work clothing (Figure 15) has been developed to meet a multitude of needs. Because of this, its use must be matched to its ability to offer the necessary protection. The manufacturer's specifications must be clearly understood, and if necessary, samples of the clothing should be tested before placing the clothing in use.

Leather clothing is widely used as protection from sparks when working in hot operations. Examples of workers who use leather clothing are welders, furnace operators, and foundry workers. The attraction of leather is that it is comfortable and has traditionally offered good protection.

Figure 15. Examples of different types of protective clothing.

Asbestos and wool clothing offers protection against heat and molten metal. Its design is a little different from leather clothing in that any metal fasteners are covered by a flap to prevent them from becoming too hot. Aprons and leggings used in the foundry industry are two popular uses for asbestos. Although asbestos has been shown to cause cancer, particularly when the individual smokes, the use of asbestos has saved lives. Only if the fabric becomes friable (broken, released into the air, and inhaled) will it become hazardous.

Aluminized clothing is worn when fighting fires, entering hot vessels for repair, for maintenance, and certain rescue work. It has an underlayer of fabric such as wool to insulate the wearer from the hot, reflective surface of the clothing. The design of the clothing may be a unitized suit protecting the whole body or specific items such as a "turnout" jacket worn by firemen.

Flame-retardant clothing protects against sparks and some fire situations. A treatment may be applied to existing clothing to gain this quality. However, when this is done, laundering may wash out the chemical that acts as the flame retardant. Some commercially developed flame-retardant clothing may be laundered many times before losing its flame-retardant qualities. A material developed for miliary pilots during the 1960's is called nomex, and its ability to char rather than melt has been credited with saving several lives.

Whenever selecting and using any type of personal protective equipment, it is important to follow the manufacturer's guidelines.

ACTIVITY 13:

What type of protective clothing would be appropriate for use in a foundry near the furnace?

_____

_____

_____

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ANSWERS TO ACTIVITIES

ACTIVITY 1

The degree of protection it will afford.

The ease with which it may be used.

ACTIVITY 2

Safety helmets – protection from flying objects, impact to the head, and electrical hazards. (Any two of the three constitutes a correct answer.)

ACTIVITY 3

Audiometric testing is done to determine hearing loss or shift. The initial test determines the baseline hearing ability and follow-up periodic testing determines further hearing shift.

ACTIVITY 4

1. Hearing protectors are divided into two groups: ear muffs and a variety of earplugs.
2. 90 dBA.

ACTIVITY 5

1. b.
2. a. False.
   b. False.
   c. True.

ACTIVITY 6

1. b.
2. c.
3. 14.

ACTIVITY 7

Any five of the following nine questions constitutes a correct answer.

1. What is the estimated contaminant concentration where the respirator will be used?
2. What is the permissible exposure level of the contaminant?
3. Is the contaminant a gas, vapor, mist, dust, or fume?
4. Could the contaminant concentration be termed immediately hazardous to life or health?
5. If the contaminant is flammable, does the estimated concentration approach the lower explosive limit?
6. Does the contaminant have adequate warning properties? (Does the worker become aware of the contaminant quickly?)
7. Will the contaminant irritate the eyes at the estimated concentrations?
8. If the contaminant is a gas or vapor, is there an available sorbent (material that will absorb, or react to and hold) that traps it efficiently?

9. Can the contaminant be absorbed through the skin as a vapor or liquid? If so, will it cause serious injury?

ACTIVITY 8

No. 3.

ACTIVITY 9

Class I – Body belts – restrain a person who might fall.

Class II – Chest harness – keeps a person upright.

Class III – Body harness – used where risk of falling is greatest.

Class IV – Suspension belts – serve as a work platform and safety belt.

ACTIVITY 10

False.

ACTIVITY 11

1. Safety toe – matches with c.
2. Conductive – matches with d.
3. Foundry – matches with a.
4. Explosive operations – matches with e.
5. Electrical hazard – matches with b.

ACTIVITY 12

Around moving machinery.

ACTIVITY 13

A face shield, protection glasses, aluminized jacket and trousers and gloves, foundry shoes, and hearing protection.

APPENDIX

ANSI-Z88.2-1980 Respirator Program Requirements

3.1 Purpose. This section establishes requirements for the use of respirators. The following requirements are supplemented by recommended practices in subsequent sections of this standard.

3.2 Permissible Practice. In the control of those occupational diseases caused by breathing air contaminated wtih harmful dusts, fumes, sprays, mists, fogs, smokes, vapors, or gases, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substibution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted or evaluated, appropriate respirators shall be used pursuant to the following requirements.

3.3 Employer Responsibility.

3.3.1 Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee.

3.3.2 The employer shall provide the respirators which are applicable and suitable for the purpose intended.

3.3.3 The employer shall be responsible for the establishment and maintenance of a respiratory protection program which shall include the general requirements outlined in Section 3.5.

3.4 Employee Responsibility.

3.4.1 The employee shall use the provided respiratory protection in accordance with instructions and training received.

3.4.2 The employee shall guard against damage to the respirator.

3.4.3 The employee shall report any malfunction of the respirator to the responsible person.

3.5 Minimal acceptable Respirator Program.

3.5.1 Standard Operating Procedures. Written standard operating procedures covering a complete respirator program shall be established and implemented to include Sections 3.5.2 through 3.5.15.

3.5.2 Program Administration. The plant or company industrial hygiene, health physics, or safety engineering department shall administer the respirator program in close liaison with the medical department. Responsibility and authority for the respirator program shall be assigned to a single person. In small plants or companies having no formal industrial hygiene, health physics, or safety engineering department, the respiratory program shall be administered by an upper-level superintendent, foreman, or other qualified person responsible to the principal manager. The administrator shall have sufficient knowledge of respiratory protection to properly supervise the respirator program.

3.5.3 Physiological and Psychological Limitations for Respirator Wearers. A physician shall determine what physiological and psychological conditions are pertinent for the wearing of different types of respirators. The respirator program administrator or his designee, using guidelines established by a physician, shall determine whether or not a person may be assigned to a task requiring the use of a respirator. This determination shall be reviewed at least annually.

3.5.4 Approved Respirators. Approved respirators shall be used. Modification of an approved respirator unauthorized by the approval agencies voids the approval.

3.5.5 Respirator Selection. The selection of the proper type of respirator shall be based upon (a) the nature of the hazardous operation or process, (b) the type of respirator hazard (including physical properties, physiological effects on the body, concentration of toxic material or airborne radioactivity level, established permissible time-weighted average concentration for toxic material, established permissible airborne concentration for radioactive material, and established immediately dangerous to life or health concentration for toxic material), (c) the location of the hazardous area in relation to the nearest area having respirable air, (d) the period of time for which respiratory protection must be provided, (e) the activities of

workers in the hazardous area, (f) the physical characteristics and functional capabilities and limitations of the various types of respirators, and (g) respirator protection factors.

3.5.6 Training. Each respirator wearer shall be given training which shall include (a) an explanation of the respiratory hazard and what happens if the respirator is not used properly, (b) a discussion of what engineering and administrative controls are being used and why respirators still are needed for protection, (c) explanation of why a particular type of respirator has been selected, (d) a discussion of the function, capabilities and limitations of the selected respirator, (e) instruction in how to don the respirator and to check its fit and operation, (f) instruction in the proper wearing of the respirator, (g) instruction in respirator maintenance and (h) instruction in recognizing and handling emergency situations.

3.5.7 Respirator Fit. Each respirator wearer shall be provided with a respirator that fits the wearer as determined by Section 6.11. Each respirator wearer shall be required to check the seal of the respirator by appropriate means prior to entering a harmful atmosphere.

3.5.8 Facial Hair, Contact Lenses, and Eye and Face Protective Devices. A respirator equipped with a facepiece shall not be worn if facial hair comes between the sealing periphery of the facepiece and the face or if facial hair interferes with valve function. The wearer of a respirator equipped with a full facepiece, helmet, hood, or suit shall not be allowed to wear contact lenses. If a spectacle, goggle, face shield, or welding helmet must be worn with a facepiece, it shall be worn so as not to adversely affect the seal of the facepiece to the face.

3.5.9 Issue of Respirators. The proper type of respirator for each respiratory hazard shall be listed in written standard operating procedures. Only persons trained to insure that proper respirators are issued shall be permitted to issue respirators to persons needing them.

3.5.10 Respirator Inspection. The respirator shall be inspected by the wearer prior to its use to insure that it is in proper working condition. Each respirator stored for emergency or rescue use shall be inspected at least monthly.

3.5.11 Monitoring Respirator Use. Supervisory personnel shall periodically monitor the use of respirators to insure that they are worn properly.

3.5.12 Monitoring Respiratory Hazard. The concentration or the airborne radioactivity level of the respiratory hazard in the work area shall be monitored initially prior to respirator selection and periodically during respirator use to insure that the proper type of respirator is being utilized.

3.5.13 Medical and Bioassay Surveillance. When applicable, medical surveillance, including bioassay, shall be carried out periodically to determine if respirator wearers are receiving adequate respiratory protection. A physician shall determine the requirements of the surveillance program.

3.5.14 Respirator Maintenance. Respirator maintenance shall be performed regularly. Maintenance shall be carried out on a schedule which insures that each respirator wearer is provided with a respirator that is clean and in good operating condition. Maintenance shall include: (a) washing, sanitizing rinsing, and drying, (b) inspection for defects, (c) replacement of worn or deteriorated parts, (d) repair if necessary, and (e) storage to protect against dust, sunlight, excessive heat, extreme cold, excessive moisture, damaging chemicals, and physical damage.

3.5.15 Respirator Program Evaluation. An appraisal of the effectiveness of the respirator program shall be carried out at least annually. Action shall be taken to correct defects found in the program.